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(54) Title of the Invention Method and device for recording and retrieving picture information

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SPECIFICATION

1. **Title of the Invention**

Method and device for recording and retrieving picture information

2 **Claims**

(1) A method for recording and retrieving picture information comprising: attaching a cassette case at a certain location on a device body; transporting roll film that is housed within the cassette case and that has a photographic film part with multiple frames [wherein the roll film is] transportable forwardly and backwardly between at least one winder shaft provided to the cassette case and another winder shaft by driving means of the device body, while positioning a specific unimaged image frame arbitrarily selected on the photographic film part at a certain photographing location of the device body and transferring a specific information image to this specific image frame by imaging means of the device body, followed by developing and fixing if needed; through electrical connection means adapted to provide attachment between the device body and the cassette case, writing information relating to the specific image frame and having been input by external input means of the device body to a readable/writeable semiconductor memory or magnetic bubble memory that is housed within the cassette case; and then reading out the information in the semiconductor memory or the magnetic bubble memory through the electrical connection means, and sending the specific image frame corresponding to the specific information to a retrieval location in the device body.

(2) A cassette adapted to house roll film and a semiconductor memory or magnetic bubble memory that are employed in a method for recording and retrieving picture information that involves transporting the roll film housed within the cassette case and having a photographic film part of multiple frames [wherein the roll film is] transportable forwardly and backwardly between at least one winder shaft provided to the cassette case and another winder shaft by driving means of the device body, while positioning a specific unimaged image frame arbitrarily selected on the photographic film part is at a certain photographing location of the device body and transferring a specific information image to this specific image frame by imaging means of the device body, followed by developing and fixing if needed; through electrical connection means detachably attached between the device body and the cassette case, writing information relating to the specific image frame and having been input by external

input means of the device body to the readable/writeable semiconductor memory or magnetic bubble memory that is housed within the cassette case; and then reading out the information in the semiconductor memory or the magnetic bubble memory through the electrical connection means, and sending the specific image frame corresponding to the specific information to a retrieval location of the device body; wherein the cassette comprises: a cassette case detachably attachable to a certain location on the device body; at least one winder shaft adapted to wind the roll film; and electrical connection means for input/output to the semiconductor memory or magnetic bubble memory and adapted to attach to and detach from electrical connection means of the device body according to attachment or detachment of the cassette case; wherein [the cassette] is adapted to transport the roll film forwardly and backwardly past a photographing location [situated on the path] from the winder shaft of the cassette case to the other winder shaft.

(3) The cassette according to claim 2 wherein the photographic film part is a transparent film part having a transparent conducting layer and a transparent photoconducting insulating layer formed on a transparent support.

(4) A device for recording and retrieving picture information comprising: a loading chamber adapted to receive attachment of a cassette provided with a readable/writeable semiconductor memory or magnetic bubble memory for saving information relating to image frames and with roll film having a film portion capable of multiple frame imaging of picture information; driving means for transporting the roll film forwardly or backwardly from one winder shaft to another winder shaft; imaging means for transferring a specific information image to the film part while positioned at an imaging location; electrical connection means adapted for attachment and detachment, depending on attachment or detachment of the cassette, to electrical connection means for input/output to and from the semiconductor memory or magnetic bubble memory of the cassette; external input means adapted for inputting information to the semiconductor memory or magnetic bubble memory from the outside through this electrical connection means; and control means for processing information input from this external input means and for controlling the driving means and the imaging means; wherein information identifying the frame of the film portion that contains the photographed picture information and information relating to the picture information is written to the semiconductor memory or magnetic bubble memory from the

external input means; and where photographed picture information is to be retrieved, the identifying information and related information is input to the control means by the external input means, whereby the driving means is halted at the frame location of the film portion corresponding to this information and the retrieval process is carried out.

(5) The device for recording and retrieving picture information according to claim 4 wherein the film part is a transparent film part having a transparent conducting layer and a transparent photoconducting insulating layer formed on a transparent support; and the imaging means is an electrophotographic copying device.

3 **Detailed Description of the Invention**

The present invention relates to a method and a device for recording and retrieving picture information, and in particular relates to [a method and a device] employing a roll of microfilm as the recording medium.

In the field of office automation, the establishment of systems for retaining and retrieving documents plays an important role in terms of the goal of increasing efficiency and productivity in office departments. The use of microfilm is one effective means for this purpose. Conventional microfilm comes in several formats such as roll film, aperture cards, microfiche, and microfilm jackets.

(1) Roll film records a continuous series of reduced document images on a film of roll form, and may be stored on a reel or housed in a magazine from which [information] can be retrieved and recovered by a microreader or a reader/printer using as an index a retrieval code that was transferred simultaneously at the time of imaging.

(2) An aperture card is a card of appropriate size (typically an IBM card) having a square window (aperture) in which a microfilm is mounted; required cards are retrieved manually or mechanically using a pre-established code for each card, and [information] is recovered by an aperture card reader.

(3) Microfiche is created by imaging documents directly onto a sheet-like film (fiche) using a special camera; the required fiche is retrieved using a serial number assigned to the fiche, and [the data] is recovered by a fiche reader.

(4) A microfilm jacket holds film strips of 6 to 12 frames each cut from a separately imaged roll film, in a pouch (jacket) constructed of transparent sheets; [information] is recovered by a jacket reader.

However, all of the utilization formats mentioned above have the drawback that, in conventional practice, the recording device that records

documents to film (i.e. performs image exposure, developing, and fixing) and the retrieval/projection device for retrieving photographed frames, such as a microreader, are separate devices. In the case of roll film, microfiche, and microfilm jackets, retrieval must be carried out while viewing the enlarged photographed images one by one in a manual operation, or by locating the photographed retrieval codes; this made prompt retrieval difficult, and required considerable time and effort. Further, the information for identifying the frames (e.g. frame number or code) will typically have been transferred to the microfilm itself, making it impossible to subsequently add information or make corrections.

[One possible way to enable] subsequent adding of information or corrections would be to input and store information identifying image frames to an external memory, but this will require memory capacity sufficient for all images that have been recorded onto large numbers of microfilms (cartridges), and a resultant disadvantage is that larger memory capacity will be needed to accommodate larger numbers of microfilm cartridges. Another disadvantage is that if it is desired to bring a microfilm cartridge to another department for use, the microfilm cartridge will be unusable if information for it has not been saved to the external memory of the retrieval device of the other department.

In view of the drawbacks of the prior art discussed above, it is a principal object of the present invention to increase the speed of retrieval of picture information that has been imaged onto roll film.

It is another object of the present invention to provide an imaging system that images documents and a retrieval system for recorded picture information with an integrated configuration.

It is yet another object of the present invention to make the device more compact overall, to a size suitable for desktop installation for example, notwithstanding the integrated configuration of the imaging system and the retrieval system.

It is yet another object of the present invention to enable subsequent addition or correction of information relating to recorded picture information (frame number, code, etc.).

Furthermore, it is yet another object of the present invention to enable retrieval of previously recorded picture information even during imaging of documents; and conversely, to enable imaging to an unrecorded part of the film to take place even during retrieval.

The present invention provides a method for recording and retrieving picture information, a cassette, and a device for recording and

retrieving picture information whereby the above objects may be attained, these respective modes being set forth hereinbelow.

The method for recording and retrieving picture information according to the present invention comprises: attaching a cassette case to a certain location on the device body; transporting roll film that is housed within the cassette case and that has a photographic film part of multiple frames [wherein the roll film is] transportable forwardly and backwardly between at least one winder shaft provided to the cassette case and another winder shaft by driving means of the device body, while positioning a specific unimaged image frame arbitrarily selected on the photographic film part at a certain photographing location in the device body and transferring a specific information image to this specific image frame by imaging means of the device body, followed by developing and fixing if needed; through electrical connection means adapted to provide attachment between the device body and the cassette case, writing information relating to the specific image frame and having been input by external input means of the device body to a readable/writeable semiconductor memory or magnetic bubble memory that is housed within the cassette case; then reading out the information in the semiconductor memory or the magnetic bubble memory through the electrical connection means, and sending the specific image frame corresponding to the specific information to a retrieval location of the device body.

The cassette according to the present invention is adapted to house roll film and a semiconductor memory or magnetic bubble memory that are employed in a method for recording and retrieving picture information that involves transporting the roll film that is housed within the cassette case and that has a photographic film part of multiple frames [wherein the roll film is] transportable forwardly and backwardly between at least one winder shaft provided to the cassette case and another winder shaft by driving means of the device body, while positioning a specific unimaged image frame arbitrarily selected on the photographic film part at a certain photographing location of the device body and transferring a specific information image to this specific image frame by imaging means of the device body, followed by developing and fixing if needed; through electrical connection means adapted to provide attachment between the device body and the cassette case, writing information relating to the specific image frame and having been input by external input means of the device body to the readable/writeable semiconductor memory or magnetic bubble memory that is housed within the cassette case; then reading out the

information in the semiconductor memory or the magnetic bubble memory through the electrical connection means, and sending the specific image frame corresponding to the specific information to a retrieval location in the device body; the cassette comprises: a cassette case detachably attachable to a certain location on the device body; at least one winder shaft adapted to wind the roll film; and electrical connection means for input/output to the semiconductor memory or magnetic bubble memory and adapted to attach to and detach from electrical connection means of the device body according to attachment or detachment of the cassette case; wherein [the cassette] is adapted to transport the roll film forwardly and backwardly past a photographing location [situated on the path] from the winder shaft of the cassette case to the other winder shaft.

The device for recording and retrieving picture information according to the present invention comprises: a loading chamber adapted for attachment and detachment of a cassette provided with a readable/writeable semiconductor memory or magnetic bubble memory for saving information relating to image frames and with roll film having a film portion capable of multiple frame imaging of picture information; driving means for transporting the roll film forwardly or backwardly from one winder shaft to another winder shaft; imaging means for transferring a specific information image to the film part while positioned at an imaging location; electrical connection means adapted for attachment and detachment, depending on attachment or detachment of a cassette, to electrical connection means for input/output to and from the semiconductor memory or magnetic bubble memory of the cassette; external input means adapted for inputting information to the semiconductor memory or magnetic bubble memory from the outside through this electrical connection means; and control means for processing information input from this external input means and for controlling the driving means and the imaging means; wherein information identifying the frame of the film portion that contains the photographed picture information and information relating to the picture information is written to the semiconductor memory or magnetic bubble memory from the external input means; and where photographed picture information is to be retrieved, the identifying information and related information is input to the control means by the external input means, whereby the driving means is halted at the frame location of the film portion corresponding to this information and the retrieval process is carried out.

Where electrophotography is employed in the present invention, it is possible to achieve [advantages] that were next to impossible in conventional microfilm systems using silver halide photographic materials and the like. Specifically, in the case of silver halide photographic materials, regardless of whether an undeveloped part is exposed by light impinging on it or when developed as-is without exposure, in either case it will no longer be possible to subsequently record an image on this part. For example, there exists a need for a method of use whereby, after roll film has been partially used to record information (image exposure, development, fixation), projection etc. [of the film] may be carried out with the remaining blank parts left unexposed and undeveloped, and additional [information] may be recorded in the blank parts thereafter if needed. However, due to the fact that it is exceedingly difficult to completely shield [the film from] the projection light, and that it is exceedingly difficult to completely shield [the film from] light so that light will not impinge on the blank parts when a film with remaining blank parts is replaced or when this film is placed in storage, it was basically impossible to subsequently use these [unexposed] parts. In particular, when roll film having blank parts is placed in a microreader in order to retrieve a part thereof for projection, in order to carry out retrieval in such a way that these blank parts are not exposed to light it will be necessary to rely on a completely non-optical retrieval method, which represents an immense drawback in terms of the device and also in practical terms; also, the fact that a visual search must be performed while advancing through each single frame meant that there was substantially no commercial value [to this approach]. Further, when reading [the film] with the microreader, if frames are advanced without knowing whether the final frame of a recorded part is followed by blank part, that part will become unintentionally exposed. While there are various possible methods for preventing this, these methods are all substantially impossible in practical terms owing to the need for onerous additional procedures during imaging.

With electrophotographic systems on the other hand, irrespective of whether a photosensitive material has been exposed or is unexposed it will be possible to subsequently reuse the material even after development, but prior to fixation, by simply cleaning it; accordingly, there will be no need to shield [the material] from light as described above, and it will be possible to use a partially recorded photosensitive material that includes remaining blank parts. Consequently, it will be possible to record picture information grouped into parts of an electrophotographic material of roll

form while leaving the remaining blank parts as is during initial use; and if necessary to subsequently record additional picture information in the blank parts. In other words, during the recording process it will not be necessary to record in succession picture information equivalent to one roll of film, and even where requests to record information of different types have occurred at random, the information can be recorded organized according to type.

The following detailed description of the present invention makes reference to the accompanying drawings.

FIG. 1 is a schematic block diagram of an embodiment of the present invention. 1 denotes film of roll form, and 2 denotes a readable/writeable memory; both are housed in a cassette. 3 denotes electrical connection means for connecting the cassette and the device body while at the same time connecting the memory 2 to electrical circuits of the device body; an arrangement whereby electrodes situated on the side face of the cassette case are received by spring electrodes provided on the device body, an arrangement whereby a light emitting diode is embedded in the cassette, and signals are exchanged with the device body through an optical link, or an arrangement whereby a magnetic sensor or coil is imprinted on the side face of the cassette and signals are exchanged with the device body through a magnetic link, would be possible. The memory 2 stores information relating to picture information (including frame numbers and codes). Accordingly, in order to prevent the contents of the memory 2 from being lost if the cassette is detached from the device body, nonvolatile RAM, for example, RAM equipped with power backup, EPROM (erasable programmable ROM), or E^2PROM (electrical erasable programmable ROM), or magnetic bubble memory, will be employed. 4 denotes driving means for transporting the roll film 1 forwardly or backwardly in the lengthwise direction; and 5 denotes image forming means for transferring an original document 6 to the roll film 1 as well as carrying out process such as developing and fixing to form a picture information. 7 denotes control/computing means with a microcomputer as the main constituent; it has a CPU 8 primarily for input/output of control commands, and ROM 9 for storing software programs. 10 denotes manual input means such as a keyboard, used to input commands and information to the microcomputer 7. 11 denotes location sensing means for sensing a specific location in the lengthwise direction of the roll film 1 and outputting a sensor signal. The microcomputer 7, and the CPU 8 in particular, present control signals to the driving means on the basis of

commands and information input from the memory 2 and the means 10, 11, and controls transport of the roll film 1, while also adding and correcting information in the memory 2, and controlling the image forming means 5.

12 denotes picture information output means used to display a specific frame selected from a plurality of frames 13 that have been formed (photographed or copied) onto the roll film. 14 denotes stored information output means for displaying a list of the stored contents of the memory 2 read out via the CPU 8, and will be provided in a preferred embodiment.

When recording an original document 6, the manual input means 10 is operated to input a command to the CPU 8, whereupon the CPU 8 will control the driving means 4 and the image forming means 5 to transfer the picture information of the original document 6 to the roll film 1 which has been positioned at a prescribed location. In association therewith, information related to the picture information (for example, the frame number, imaging date and time, a unique retrieval code, brief comments on content, etc.) will be written to the memory 2 in the cassette using the manual input means 10. Naturally, instead of entering [information] through a operation for each individual [frame], where information such as employee ID number, document number, time stamp etc. is composed as sequential data, automatic rather than manual recording would be possible. That is, [the information] may be written sequentially to the memory 2 in cooperation with digital sequential data of a set paper tape or magnetic tape. In this case, operation of the manual input means 10 will merely involve activating a start switch.

During retrieval, the manual input means 10 is operated to input information identifying a desired image frame 13 (a code, date and time, frame number, etc.; however, this identifying information must be included in the information related to the picture information described previously), and a retrieve command is input. The CPU 8 will then control the driving means 4 to advance the roll film 1 to the vicinity of the prescribed retrieval location, and when the location sensing means 11 senses that the correct identified location has been reached, will halt advance. At this location, the picture information can be displayed by the picture information output means. In this case, if there is a need to add or correct the related information for the retrieved picture information, the data can be added or updated in the memory 2 by the manual input means 10.

It will be possible to additionally record new picture information during retrieval, or conversely, to retrieve [other picture information] during recording.

FIG. 2 is a simplified schematic of a preferred embodiment. The roll film 1 of fixed width and indefinite length is positioned with both ends attached to winder shafts 21, 22 of the cassette, allowing it to be wound in a roll. One winder shaft 21 rotates in the clockwise direction in the drawing (hereinafter termed forward rotation) while driven by a winding motor 23, to transport the roll film 1 leftward in the drawing (hereinafter termed the leftward direction). The other winder shaft 22 rotates in the counterclockwise direction in the drawing (hereinafter termed reverse rotation) while driven by another winding motor 24, to transport the roll film 1 rightward in the drawing (hereinafter termed the rightward direction). The roll film 1 is specifically either 8 mm or 16 mm wide and is composed of a transparent leading edge part 1a of a primarily polyester, tape-shaped transparent support, a contiguous opaque part 1b of an opaque layer supported on a transparent support, and a contiguous transparent film part 1c for electrophotography having a transparent conducting layer and a transparent photoconducting insulating layer sequentially formed on a transparent support. This transparent film part 1c has light polarizing characteristics, and has perforations (holes) 25 spaced at fixed pitch along one widthwise edge. The memory 2 is housed in the cassette with its input/output electrode group 3a situated on the side face of the cassette. Where the roll film 1 has a length equivalent to about 1,000 frames, a memory 2 storage capacity of about 6 to 7 kilobytes will suffice. An input/output spring electrode group 3b situated on the device body side for [connection with] the input/output electrode group 3a of the cassette is situated in the section into which the cassette will be loaded.

In the transparent film part 1c, a zone between two perforations 25, 25 corresponds to a single image frame to which the electrophotographic device 5 provided as the image forming means will transfer picture information of an original document. The electrophotographic device is of known design, and includes a charging section, an exposing section, a developing section, and a fixing section.

Meanwhile, several sensor mechanisms are arranged along the path of advance of the roll film 1; 26 denotes a leading edge sensor element for sensing the leading edge of the opaque part 1b, and 27 denotes a perforation sensing photoreceptor for sensing the perforations 25. 28

denotes a polarized light source whose light is guided into two systems. One of these is [an optical path] incident on the perpendicular to the path traveled by the perforations and leading to a perforation-sensing photoreceptor 27 via a polarizing filter 29 that is disposed to the opposite side of the roll film 1; it is used to detect the presence of the perforations 25. The use of the polarizing filter 29 for the purpose of utilizing the polarized nature of the polarized light source 28; it functions such that when light emitted from the polarized light source 28 is transmitted through the roll film 1 and impinges on the photoreceptor 27, the quantity of light will be substantially zero. Consequently, the polarization plane of the polarizing filter 29 will be established so as to have a conjugated relationship with the polarization plane of the transparent film part 1c. The other system is [an optical path] over which light traveling along the direction of advance of the roll film 1 impinges on a reflecting mirror 30 which deflects the optical path to one approximately perpendicular to the roll film 1 so as to impinge on the leading edge sensor element 26 which is situated on the opposite side. Here, while the light source 28 is employed in common for the two systems, separate [light sources] could be provided, and a light-emitting diode (LED) could be used as the light source. Further, while in the above example, since the transparent film part 1c has a polarized nature, this characteristic was utilized [for sensing], but other means for sensing the perforations 25 would be acceptable instead. For example, one method would be to situate the light source and the photoreceptor (a photoelectron multiplier) on the same side of the roll film 1, and sense whether perforations 25 are present by detecting reflection from the film surface. Also, while in this case perforations 25 are employed as the information source for identifying frame locations, no particular limitation to perforations is implied thereby. As a specific example, a method whereby [the film] is pre-printed with blip marks (optical marks) in a prescribed code format, and these marks are optically sensed, or a system wherein optical marks are recorded during the developing process (with the proviso that sensing of unimaged sections will be [accomplished through] sensing based on distance from a final mark), would also be acceptable.

The configuration of the above mechanism systems has been shown in conceptual terms; a specific configuration example is depicted in FIG. 3. FIG. 3 depicts the film charging portion of the device as seen from above. The roll film 1 has been pre-wound onto two winding reels 31, 32 and is housed within a cassette case 33; the memory 2 is housed within the

cassette case 33 as well. The roll film 1 inside the cassette case has a structure generally comparable to the magnetic tape of a music compact cassette, or to the cassette tape of a VTR for example. Hereinbelow, the assembly containing the roll film 1 and the memory 2 housed within the cassette case 33 shall be designated as the "cassette 34." As depicted in FIG. 4, which shows a cross section taken along line IV-IV in FIG. 3, the cassette 34 is loaded into a cassette loading chamber 35 of the device, and the roll film 1 is then drawn by a take-up mechanism, not shown, over tape guides 36, 37 and stretched between the tape guides 36, 37, while the input/output electrode group of the memory 2 is urged into contact with the corresponding input/output spring electrode group 3b on the device side. Along the path of advance of the tensioned roll film 1 is disposed the light source 28 for illuminating the perforations; disposed facing it is a photoreceptor element body 38 that integrally incorporates the leading edge sensor element 26 and the photoreceptor 27 for sensing the perforations. Next, the electrophotographic device 5 is positioned. The electrophotographic device 5 includes an optical system 5a having a copying lens, and a sequentially arranged charging/exposing chamber 5b (at a location corresponding to the optical system 5a), a developing chamber 5c, and a fixing chamber 5d.

The cassette 34 depicted in FIG. 3 is of a type furnished with two shafts, but a type furnished with a single shaft would also be acceptable. Cassettes of single shaft type adapted to accommodate a roll of silver halide film are already in actual use and their design need not be described here, [except to note that] in terms of operation, when a single-shaft cassette housing electrophotographic film is installed at a prescribed location of the device body, the leading edge of the film will be drawn out by a take-up mechanism of known art design, and will be engaged and wound onto a winder shaft provided on the device body side (corresponding to symbol 21 in FIG. 2).

The electrical connection means for the memory 2 between the cassette 34 and the device body described above is of electrode type; however, a type adapted to either exchange optical signals or exchange magnetic signals would also be acceptable.

To read out picture information, a separately provided projection light source (not shown) will be directed directly onto the roll film 1, and [an image] projected onto a screen via an appropriately situated lens means or optical path deflecting means. Alternatively, dual use of the lamp (in most instances, an infrared lamp) installed in the fixing chamber

5d would also be possible. Projecting means are described in (several) co-pending applications filed by the applicant.

Next, the electrical control system will be described with reference to FIG. 2. Control is primarily carried out by the CPU 8 which is included in the microcomputer 7. The CPU 8 is connected via I/O ports to several functional circuits.

First, the leading edge sensor element 26 is connected to the CPU 8 via a port 39. The perforation sensing photoreceptor 27 is connected to a pulse counter 40, and also connected to driver circuits 41, 42 that drive the winding motors 23, 24 of the winder shafts 21, 22; the pulse counter 40 is presented with a count pulse, while the driver circuits 41, 42 are presented with a signal for stopping the frame 13 at the correct location.

The driver circuits 41, 42 are connected to respective motor current sensing circuits 43, 44; one motor current sensing circuit 43 presents a signal to an I/O port 45 via a signal line S5, and a feedback signal is presented to the driver circuit 41 from this I/O port 45 via signal lines S1, S3. The other motor current sensing circuit 44 presents a signal to an I/O port 39 via a signal line S6, and a feedback signal is presented to the driver circuit 42 from this I/O port 39 via signal lines S2, S4.

The pulse counter 40 is connected to an I/O port 46; three control signal lines S_H, S_U, S_D are input to this I/O port 46, and a data bus DBUS is connected as well. The signal S_H is a hold signal, that is a signal to hold the count; the signal S_U is an upcount signal, i.e. an instruction signal to increment the count; and the signal S_D is a downcount signal, i.e. a signal to decrement the count.

The electrophotographic device 5 is connected to the CPU 8 via an I/O port 47, and is operated by control signals for the CPU 8.

The input keyboard 10 is connected to the CPU 8 via an I/O port 48 so that instruction signals can be input to the CPU 8 from the keyboard 10, and various kinds of data can be saved to the memory 2.

Since the roll film 1 is provided in cassette form, there will be provided a cassette loading switch 49 whose contact closes automatically when the cassette 34 is loaded; this closed contact signal is input to the CPU 8 via an I/O port 48.

This picture information recording/retrieving device is also furnished with an electronic control system that during recording or during retrieval is able to bring a single frame corresponding to a single perforation to a stop at a specific location with high accuracy. Expressed in terms of operation, from the current stop location, if a desired frame is

to be retrieved frame advance will initially take place at high speed, switching to lower advance speed as the desired frame approaches, and then stopping advance immediately once the perforation corresponding to the desired frame is found. Thus, [the film] can be stopped at the prescribed location faster and more accurately. FIG. 5 is a circuit diagram illustrating the above, and depicts in detail the perforation sensing photoreceptor 27, the forward rotation driver circuit 41, the reverse rotation driver circuit 42, and the motor current sensing circuits 43, 44.

In the perforation sensing photoreceptor 27, light impinging on the perforations is detected by two photodiodes PD_1, PD_2. The photodiodes PD_1, PD_2 are connected to the two inputs of an operating amplifier OP_1 so as to have mutually opposite polarity, and are designed to detect at a time lag the light passing through the perforations, and to then output a voltage waveform of a continuous series of trapezoidal pulses in the positive and negative directions. As depicted in detail in FIG. 6, planar photodiodes insulatedly separated in the center are employed as the photodiodes PD_1, PD_2, with the width of a single photodiode being slightly larger than the width of a perforation. As the transparent film part 1c advances from left to right in the drawing, the photodiode PD_1 will independently output a trapezoidal pulse in the positive direction, shown by the broken line in FIG. 6 (b), while the other photodiode PD_2 will independently output a trapezoidal pulse of opposite polarity from the above. The two output pulses will be point-symmetric about the center junction of the two photodiodes PD_1, PD_2, and when the two pulses undergo current/voltage conversion and synthesis by the operating amplifier OP_1 there will be produced a voltage waveform of trapezoidal pulses that oscillate between positive and negative as depicted in FIG. 6 (c). The approximate center point of this positive-negative change of the waveform will correspond to zero potential, and the temporal location of this zero potential will correspond to the junction of the two photodiodes PD_1, PD_2, in other words, the center location of the perforation 25.

This positive/negative sensor waveform signal is input to the pulse counter 40, which will count up or count down in increments of 1. In this example, count number corresponds to frame location; where the count number is n, this will correspond to the current n-th frame location in the transparent film part 1c starting from the trailing edge of the opaque part 1b.

The sensor waveform signal described above is also input to zero potential sensing circuits 41a, 42a included in the driver circuits 41, 42.

The zero potential sensing circuit 41a is used at times of forward rotation, and senses the zero cross from negative to positive; the zero potential sensing circuit 42a is used at times of reverse rotation, and senses the zero cross from positive to negative. Analog switches 50, 51 are connected to the output portions of the zero potential sensing circuits 41a, 42a; the analog switches 50, 51 are controlled by signals S3, S4 from the CPU 8 so as to go OFF during high-speed advance and ON during low-speed advance. Specifically, semiconductor switching elements, such as FET or CMOS, will be used as the analog switches, and based on the result of comparison of frame location by the CPU 8, will go ON at the point in time that the frame previous to the targeted frame is counted. When the center location of the perforation that corresponds to the targeted frame is sensed, a zero potential signal is output, and the signal is presented to the drive portion 41a or 42b of one of the driver circuits 41, 42, thereby turning off the drive motor to halt [the frame] precisely at the center location of the perforation.

Using a D/A converter, the forward rotation drive portion 41b will convert to an analog quantity the target constant speed advance signal S1 that has been set by the CPU 8, and current will be supplied to the motor 23 via an operating amplifier OP_2. The motor current sensing circuit 43 is connected via a comparator OP_4 to the motor 23,; and a motor stop signal S5 is output from a buffer via an RC integrator circuit that determines a time constant such that excessive current occurring for a long time in the event that rotation in inhibited, e.g. when the endpoint of windup is reached will be sensed, while large current occurring for a short time during motor startup will not be sensed.

The reverse rotation drive portion 42b is comparable to 41b; S2 denotes a constant speed advance signal, 53 denotes a D/A converter, OP_3 denotes an operating amplifier, OP_5 denotes a comparator, 44 denotes the motor current sensing circuit, and S6 denotes a motor stop signal.

Next, operation of the picture information recording/retrieving device will be described based on the general flow chart of FIG. 7, and the detailed flow charts of FIG. 8 (A) through FIG. 8 (F).

First, when the cassette 34 is loaded and [the device] is started, there are two selectable modes, from which the appropriate one will be selected. The first mode is a mode for recording document information; in this mode, document information will be transferred to a desired frame location (hereinafter termed frame address) of the transparent film part 1c, and information relating to this document information will be written

to the memory 2 through operation of the keyboard 10. In this mode, [recording may take place] to a single frame only, or to several frames [either by recording] to a series of consecutive frames or skipping among frame locations. The second mode is a mode for retrieving recorded document information; in this mode, a frame address will be input from the keyboard 10, and the recorded frame identified by that frame address will be stopped at the prescribed location for display or [printout] in hardcopy by the picture information output means 12 (FIG. 1). At this time, if related information is to be added or modified for the recorded frame, the contents of the memory 2 will be overwritten through operation of the keyboard 10. If no data addition or modifications are made, the contents of the memory 2 will be unchanged.

It is also possible for the above first mode and second mode to be combined. Specifically, the second mode may be executed after executing the first mode. Or, conversely, in [another] combined mode, the first mode may be executed after executing the second mode.

When the first mode, the second mode, or a combined mode is completed, the cassette is removed and operation terminates.

Turning now to a more specific description with reference to FIG. 2, the cassette 34 is loaded into the cassette loading chamber 35 of the device. The cassette loading switch 49 will go ON automatically, and this signal will be input to the CPU 8 via the I/O port 48 so that the device itself goes into operational status. In preferred practice, the roll film 1 will be driven on the basis of this signal. Alternatively, the driver circuit 42 could be started by a Start command input from the keyboard 10. The roll film 1 will be advanced in the rightward direction by the winding motor 24, and when the leading edge of the opaque part 1b is sensed by the leading edge sensor element 26, travel of the roll film 1 will be halted. If [the leading edge] is not sensed, rightward travel may continue, or in consideration of the possibility of sensor failure, [the film] may be wound on the right winder shaft 22 to the limit, and when the roll film 1 no longer moves, the motor current sensing circuit 44 may operate and stop the motor 24.

In either event, once travel of the roll film 1 halts, next, the motor 23 will be driven and the tape body 1 will be advanced in the leftward direction at constant speed.

The roll film 1 will continue to travel without sensing the boundary of the opaque part 1b and the transparent film part 1c, and when the perforation sensing photoreceptor 27 senses the first perforation 25 of the

transparent film part 1c, travel of the tape will come to a halt. For convenience, the address of the frame corresponding to this first perforation will be termed the first address. Accordingly, the count number n of the counter circuit 40 will directly represent the frame address, indicating that [the film] is currently at the n-th frame position. Of course, there are other conceivable methods for the format for specifying frame address, so this should not be construed as limiting.

Next, where the recording mode is photographing mode and [the film] has stopped at a specific frame, a decision will be made whether to write or overwrite related data to that frame. If addition or correction is needed, the contents of the memory 2 will be updated by inputting data from the keyboard 10.

In the next step, the desired frame will be advanced to a prescribed location (either a prescribed copying location or a prescribed image output location). Using the keyboard 10, the frame address will then be input to a register in the CPU 8. Since the current position of the frame has been pre-keyed into a separate register of the CPU 8 via the I/O port 46, by comparing the two sets of data the CPU 8 can decide whether to advance in the leftward direction or advance in the rightward direction. At this time, a Start command may be input from the keyboard in association with input of the frame address data. In this example, input of the frame address by itself serves as the Start command. Depending on the decision by the CPU 8, either the driver circuit 41 or 42 will be actuated. At the same time, a decision will be made as to whether to carry out high speed travel or low speed travel; [the film] will travel at high speed if the address differential exceeds a predetermined fixed value or at low speed if [the address differential is] equal to or less than [the fixed value]. During travel, if this address differential goes below the fixed value, travel will switch automatically to low speed. When [the location] of the previous frame is reached, the zero potential sensing circuit 41a or 41b shown in FIG. 5 will be activated, stopping [the film] precisely at the corresponding specified address.

In the next step, a decision as to whether to proceed with tape travel will be made by a human operator. If [the decision is] to no longer proceed with retrieval, an operation to record to the specified frame will be executed. The original document will be positioned at prescribed location, and as the transparent film part 1c which has been charged in the charging/exposing chamber 5b is advanced sequentially in one-frame increments, the optical system 5a will be operated and electrostatic

copying will be carried out in known fashion through the developing chamber 5c and the fixing chamber 5d (FIG. 3). This series of operations will be carried out by a program stored in the ROM 9 (FIG. 1), with the CPU controlling the exposure and film advance operations by issuing appropriate commands. Of course, the basic command to copy [will be made] though keyboard 10 operation.

Usually, before or after this copying operation, data relating to this recorded picture, for example, the imaging date, class code, title, and so on will be written to the memory 2 from the keyboard 10.

FIG. 9 depicts another modified embodiment of the roll film 1, of a type in which the transparent film part 1c lacks perforations. This is because, in association with the considerable difficulty in detecting through-holes in the transparent film part 1c, special measures are required as shown in the embodiment above. The roll film 1 of FIG. 9 lacks a leading end transparent part, and the opaque part 1b is affixed directly to the winder shaft.

The configuration of a device employing the roll film 1 of FIG. 9 is shown in overview in FIG. 10. This device corresponds to the device depicted in FIG. 2, with the same reference symbols as in FIG. 2 indicating like or comparable elements.

The opaque part 1b whose leading end is affixed to the winder shaft 21 is provided with a hole 100 a short distance from the leading edge. This hole 100 is adapted to be sensed by a light emitting diode 101 and a photoelectric conversion element 26 for photoreception purposes.

102 denotes a rotary encoder. Once the cassette has been loaded, a roller portion of this rotary encoder 102 will normally be held pressed against the roll film 1 and used both to sense the travel speed of the roll film 1 and to sense frame addresses. The output of the rotary encoder 102 will be input to the counter circuit 40.

Other arrangements and operation are generally similar to those in the preceding embodiment and will not be discussed.

This device affords the advantage that the difficulty in detecting perforations in the transparent film part 1c can be overcome.

Also, while in the preceding embodiment, information relating to frames is saved to memory housed within the cassette, and the memory contents are manipulated using external input means, such an information manipulation format is not limited to electrophotographic film, and it would be acceptable to use dry silver film, for example.

According to the present invention set forth above, the position of the roll film will be sensed by externally specifying a frame address while controlling tape travel on the basis of control commands from control/computing means, thus affording the advantage of being able to rapidly retrieve specified frames.

Moreover, because the roll film and a semiconductor memory or magnetic bubble memory adapted for reading/writing of information corresponding to frames of this roll film are housed within the cassette, and the recorded contents of the memory can be updated, a resultant advantage is the ability to enhance the "table of contents" relating to imaged frames, and this enhanced "table of contents" can contribute to faster retrieval. Also, since the memory is housed in the cassette, recording and retrieval will be possible even if the cassette is installed in a device body in another department.

4. Brief Description of the Drawings

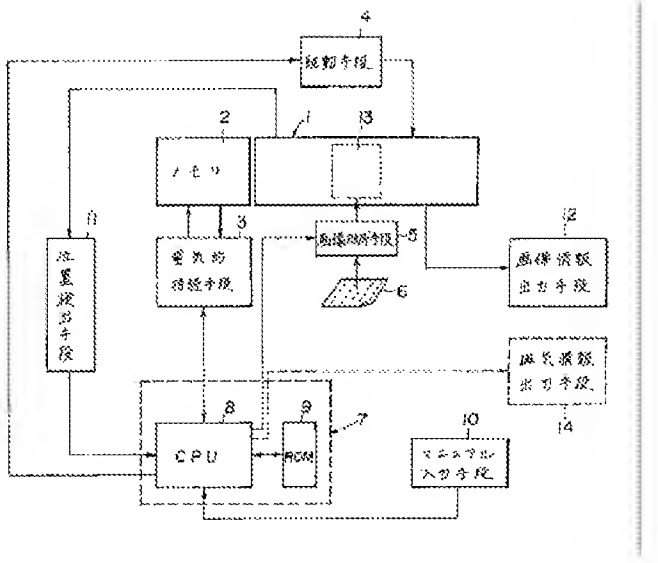
FIG. 1 is a schematic block diagram of an embodiment of the present invention; FIG. 2 is a block diagram of mechanical system placement relationships and the electrical system in a more specific embodiment; FIG. 3 is an illustration depicting specific placement of the cassette and the mechanical system; FIG. 4 is a sectional view taken along line IV-IV in FIG. 3; FIG. 5 is a principal circuit diagram of the electrical system; FIG. 6 is an illustration of perforation sensing; FIG. 7 is a general flow chart illustrating the embodiment of the present invention; and FIGS. 8 (A) to 8 (F) are detailed flow charts. FIG. 9 is an illustration of a modified embodiment of the roll film; and FIG. 10 is a schematic diagram of a device according to another embodiment of the present invention. In the drawings:

1 ... roll film; 1c ... transparent film part; 2 ... memory; 3 ... electrical connection means; 5 ... image forming means; 7 ...control/computing means (e.g. a microcomputer); 8 ... CPU; 9 ... ROM; 10 ... manual input means; 11 ... location sensing means; 12 ... picture information output means; 13 ... image frame; 21, 23 ... winder shafts; 22, 24 ... winding motors; 27 ... perforation sensing photoreceptor; 33 ... cassette case; 35 ... cassette loading chamber; 41, 42 ... driver circuits; 40 ... counter circuit; 102 ... rotary encoder

Applicant: FUJI PHOTO FILM CO. LTD.

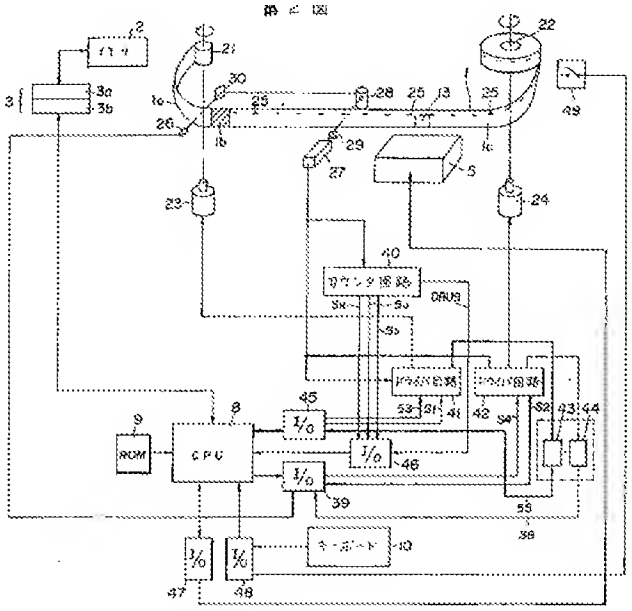
Agent: MITSUISHI Shiro, Patent Attorney (1 additional)

FIG. 1



2: memory; 3: electrical connection means; 4: driving means; 10: manual input means; 11: location sensing means; 12 picture information output means; 14: magnetic information output means

FIG. 2



2: memory; 10: keyboard; 40: counter circuit; 41: driver circuit; 42: driver circuit

FIG. 3

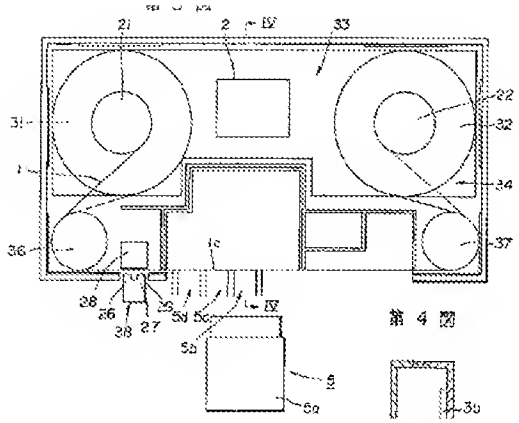


FIG. 4

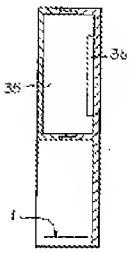
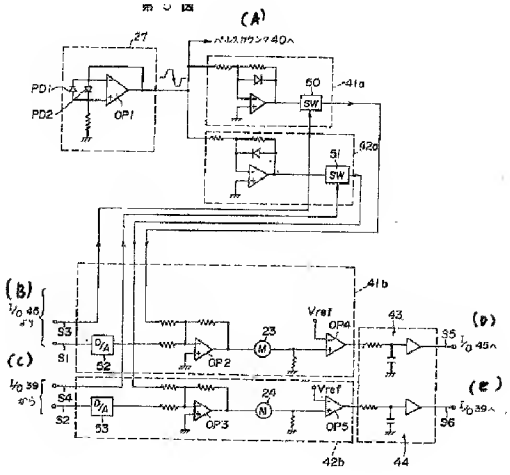
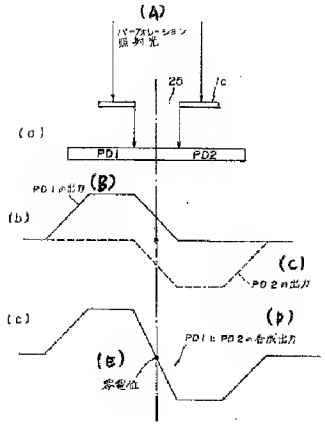


FIG. 5



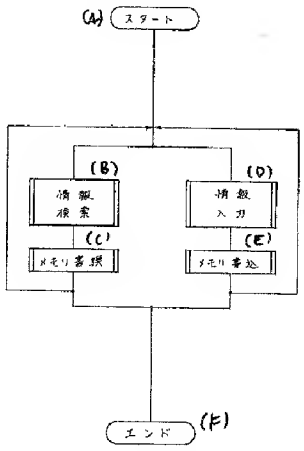
(A) to pulse counter 40; (B) from I/O 45; (C) from I/O 39; (D) to I/O 45; (E) to I/O 39

FIG. 6



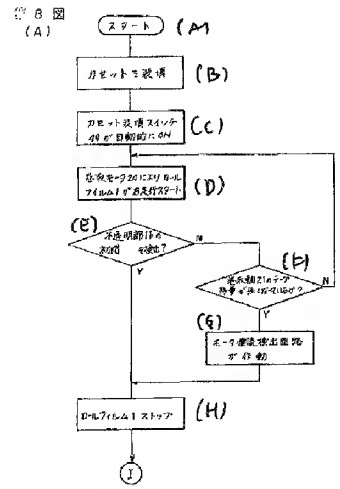
(A) perforation impingent light; (B) PD1 output; (C) PD2 output; (D) synthesized output of PD1 and PD2; (E) zero potential

FIG. 7



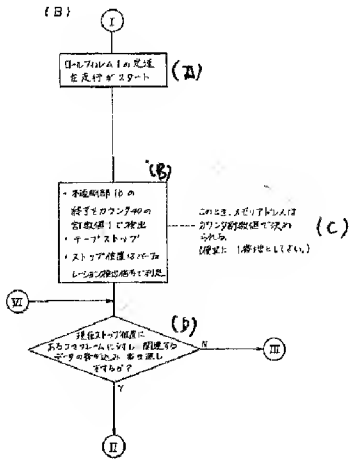
(A) START, (B) information retrieval; (C) information input; (D) memory overwrite; (E) memory write; (F) END

FIG. 8 (A)



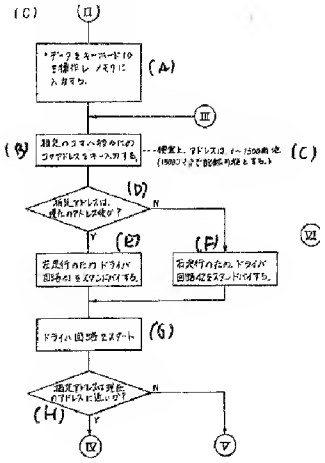
(A) START, (B) Load cassette; (C) Cassette loading switch 40 ON automatically; (D) Start rightward travel of roll film 1 by winding motor 24; (E) Leading edge of opaque part 1b sensed?; (F) Remaining amount of tape on winder shaft 21 gone? (G) Motor current sensor circuit operates; (H) Stop roll film 1

FIG. 8 (B)



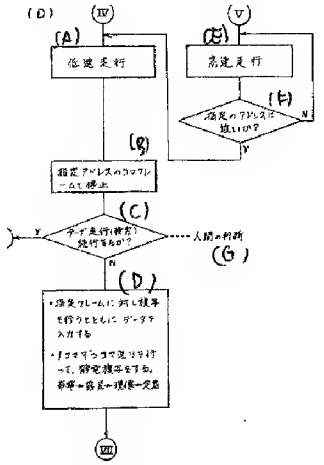
(A) Start leftward travel of roll film 1; (B) ・Detect end of opaque part 1b by count value 1 of counter 40; ・Stop tape; ・Stop location determined by perforation sensing signal; (C) At this time, memory address determined by counter count value (for convenience, may be designated first address; (D) Write/overwrite related data to frame at current stop location?

FIG. 8 (C)



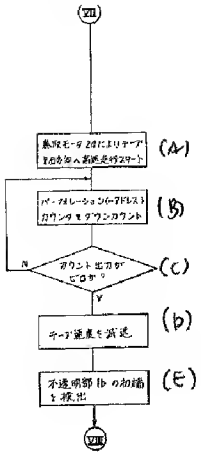
(A) Input data to memory through keyboard 10 operation; (B) Input frame address for moving to specified frame; (C) For convenience, addresses are 1 -1500 (up to 1500 frames recordable); (D) Specified address after current address?; (E) Set driver circuit 41 for leftward travel to standby; (F) Set driver circuit 42 for rightward travel to standby; (G) Start driver circuit; (H) Specified address close to current address?

FIG. 8 (D)



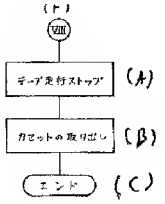
(A) Low speed travel; (B) Stop at frame of specified address; (C) Proceed with tape travel (retrieval)?; (D) • Copy specified frame and input data; • Electrostatic copying while advancing in one-frame intervals; Charging → Exposing → Developing → Fixing; (E) High speed travel; (F) Close to specified address? (G) Human decision

FIG. 8 (E)



(A) Start high speed travel of tape in rightward direction by winding motor 24; (B) Downcount perforations (=addresses) in counter; (C) Count output zero?; (D) Reduce tape speed; (E) Sense leading edge of opaque part 1b

FIG. 8 (F)



A) Stop tape travel; (B) Remove cassette; (C) END

FIG. 9

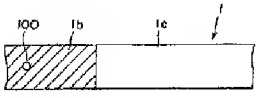
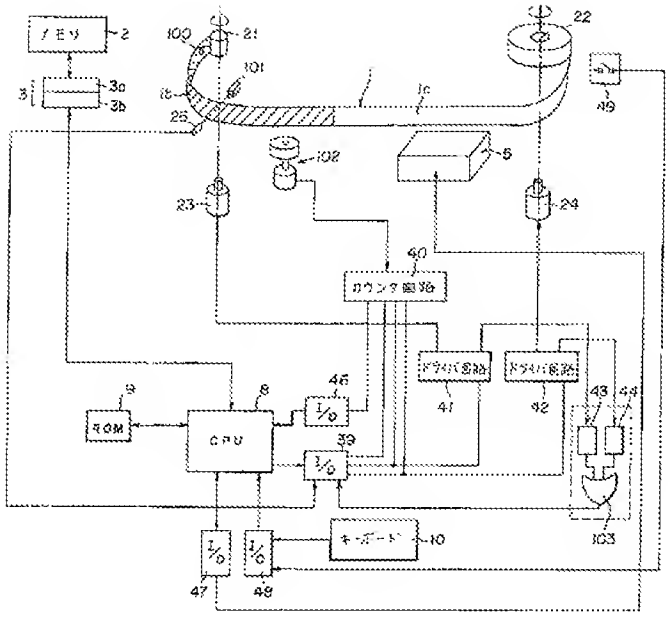


FIG. 10



2: memory; 10: keyboard; 40: counter circuit; 41: driver circuit; 42: driver circuit